

DEPARTMENT OF THE ARMY
Omaha District, Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

:NOTICE: Failure to acknowledge :	Solicitation No. DACW45 02 B 0014
:all amendments may cause rejec- :	
:tion of the bid. See FAR :	Date of Issue: 19 May 2003
:52.214-3 of Section 00100 :	Date of Opening: 10 July 2003
Amendment No. 0008	
30 June 2003	

SUBJECT: Amendment No. 0008 to Specifications and Drawings for Construction of
FLOOD PROTECTION PROJECT, VAN BIBBER CREEK, ARVADA, CO
Solicitation No. DACW45 02 B 0014.

TO: Prospective Bidders and Others Concerned

1. The specifications and drawings for subject project are hereby modified as follows (revise all specification indices, attachment lists, and drawing indices accordingly).

a. Specifications. (Descriptive Changes.)

(1) Section 02222 Page 3, paragraph 2.1.12: Delete the title of the paragraph "Drain Blanket". Rename the paragraph title "Drain Blanket and Gravel Drainage Material". Delete the body of paragraph 2.1.12 and replace with the following, "Drain blanket and gravel drainage material shall meet requirements of paragraph 1.3.9 of specification section 02210."

(2) Section 03100 Page 2, paragraph 2.1.2: Add the following to the end of the paragraph, "A chord length not to exceed 4 feet shall be used to form radius walls for the underground conduit (box culvert) in the downstream segment of the project."

(3) Section 03100 Page 2, paragraph 2.1.3: Add the following sentence at the end of the second sentence, "Scott System product #173 Field Stone liner with $\frac{3}{4}$ " depth of relief is an acceptable form liner for the aboveground concrete channel walls."

(4) Section 03301 Page 15, paragraph 2.18: Add the following to the end of the paragraph, "The portion of the concrete box culvert that will not be visible to the public may be standard grey in color. The bridge rail and other sections that are visible to the public shall be colored concrete meeting requirements of this paragraph."

(5) Section 03301 Page 15, paragraph 2.19: Add the following to the end of the paragraph, "Graffiti coating shall also be applied to all exposed concrete surfaces of box culverts, to include tube and bridge rail sections."

(6) Section 03301 Page 38, paragraph 3.18: Delete the last sentence of the paragraph "Four coats are recommended." Replace with the following, "Four coats shall be applied to all surfaces designated to receive graffiti coating."

b. Specifications (New and/or Revised and Reissued). Delete and substitute or add specification pages as noted below. The substituted pages are revised and reissued with this amendment.

<u>Pages Deleted</u>	<u>Pages Substituted or Added</u>
Section 02246 Grouted Stone Boulders	Section 02246 Grouted Stone Boulders
Section 02240 Stone (Riprap) Protection	Section 02240 Stone (Riprap) Protection

c. Drawings (Not Reissued). The following drawing sheets of drawing are revised as indicated below with latest revision date of 30 June 2003. These drawings are not reissued with this amendment.

Downstream Segment

(1) Sheet C-5, (Typical Sections II): Add Note 3 as follows, "3. Unless noted otherwise, riprap gradation shall match riprap thickness shown."

(2) Sheet C-6, (Grouted Stone Drop Details): Add Note 4 as follows, "4. Unless noted otherwise, riprap gradation shall match riprap thickness shown."

(3) Sheet S-2, (Conduit, Plan, Section & Details): Delete the note on the conduit plan regarding construction joint spacing. Replace note with the following "Construction Joints @ 30'-0" max. spacing along length of conduit CJ-4 (top slab), CJ-3 (walls), CJ-14 (base slab)"

(4) Sheet U-1, (General Plan, Utility Relocations, Sheet 1): Delete Note 5. Revise Note 5 as follows "City of Arvada to Install Valves prior to construction to isolate sections of water line within excavation limits. Contractor shall support and protect water line during construction or remove and replace using new materials".

(5) Sheet U-2, (General Plan, Utility Relocations, Sheet 2): Delete Note 8. Revise Note 8 as follows "Water main to be isolated by City of Arvada using existing valves. Contractor shall remove and replace using new materials or support and protect existing water main during construction".

Upstream Segment

(6) Sheet Y-4, (Legend): Add the following acronym and definition to the legend, "H.B.P." - "Hot Bituminous Pavement".

(7) Sheet C-1, (Plan and Profile, Sta. 6+10 to Sta. 15+00): Delete 18" riprap gradation between Sta. 9+48 to Sta. 9+58. Replace with 24" riprap gradation.

(8) Sheet C-1, (Plan and Profile, Sta. 6+10 to Sta. 15+00): Delete 18" riprap gradation between Sta. 9+48 to Sta. 9+58. Replace with 24" riprap gradation.

(9) Sheet C-2, (Plan and Profile, Sta. 15+00 to Sta. 23+00):

Delete 18" riprap gradation between approximate Sta. 15+39.25 to Sta. 15+49.25. Replace with 24" riprap gradation.

(10) Sheet S-6, (Oak Street Culvert Modifications): Add the following General Note applicable to the plan, sections, and details, "Provide only an expansion joint (type EJ-2 on sheet S-5) at all locations where the new slab abuts existing bridge walls."

(11) Sheet B-1, (Miller Street Bridge), Section A: Delete the following note, "2" Min. H.B.P. Wearing Surface Over Waterproofing Membrane". Replace with the following note, "2" min. H.B.P. wearing surface over bituminous tack coat. Concrete surface shall be finished according to requirements in paragraph 3.9.1 of specification section 03301, and shall not receive a smooth finish. Reference specification section 02552 for bituminous tack coat requirements."

d. Drawings (Reissued). The following drawing sheets are revised with latest revision date of 30 June 2003, and reissued with this amendment.

Downstream Segment

- (1) Sheet C-4, (Typical Section I)

Upstream Segment

- (2) Sheet C-4, (Typical Channel Sections I)
(3) Sheet C-4A, (Typical Channel Sections II)
(4) Sheet C-5, (Typical Channel Sections III)
(5) Sheet C-6, (Grouted Stone Drop Details)
(6) Sheet S-1, (Structural Plan & Profile of Channel, Sta. 21+12 to Sta. 23+00)
(7) Sheet U-1, (Utility Relocations and Adjustments)

2. This amendment is a part of the bidding papers and its receipt shall be acknowledged on the Standard Form 1442. All other conditions and requirements of the specifications remain unchanged. If the bids have been mailed prior to receiving this amendment, you will notify the office where bids are opened, in the specified manner, immediately of its receipt and of any changes in your bid occasioned thereby.

a. Hand-Carried Bids shall be delivered to the U.S. Army Corps of Engineers, Omaha District, Contracting Division (Room 301), 106 South 15th Street, Omaha, Nebraska 68102-1618.

b. Mailed Bids shall be addressed as noted in Item 8 on Page 00010-1 of Standard Form 1442.

3. Bids will be received until 2:00 p.m., local time at place of bid opening, 10 July 2003.

U.S. Army Engineer District, Omaha
Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

30 June 2003
MFS/4411

SECTION 02240

STONE (RIPRAP) PROTECTION

PART 1 GENERAL

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SECTION 02240

STONE (RIPRAP) PROTECTION

PART 1. GENERAL

1.1. SUMMARY

The work covered by this section consists of furnishing all plant, labor, equipment and materials, and performing all operations in connection with the construction of stone protection for the channel in accordance with this specification and as shown on the plans and as directed by the Contracting Officer's Representative. Stone protection material shall consist of all stone to be furnished for riprap and granular bedding material. The Contractor shall control operations during production of stone protection material to ensure material delivered and placed will meet all specification requirements. The Contractor shall perform all sampling and testing required for quality control in accordance with specification section \=01451=\ CONTRACTOR QUALITY CONTROL, and as specified herein. Quarry operators shall be responsible for operating and conditioning all quarry areas (after operations are complete) in accordance with all applicable Federal, State, and local laws and regulations.

Requirements for grouted stone boulders are found in specification section \=02246=\, GROUTED STONE BOULDER CONSTRUCTION.

1.2. REFERENCES

Publications listed below form a part of this specification section to the extent referenced. Publications are referenced in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

\-AASHTO T 103-78\ (1978) Soundness of Aggregates by Freezing and Thawing (Ledge Rock-Large Specimen)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

\-ASTM C 33-\ (1990) Concrete Aggregates

\-ASTM C 88-\ (1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

\-ASTM C 127-\ (1993) Specific Gravity and Absorption of Coarse Aggregate

\-ASTM C 136-\ (1995a) Sieve Analysis of Fine and Coarse Aggregates

\-ASTM C 535-\ (1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

\-ASTM C 881-\ (1999) Epoxy-Resin-Base Bonding Systems for Concrete

\-ASTM C 1107-\ (1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

\-ASTM D 75-\ (1992) Standard Practice for Sampling
Aggregates

\-ASTM D 5519-\ (1994) Particle Size Analysis of Natural and
Man-Made Riprap Materials

STATE DEPARTMENT OF HIGHWAYS, DIVISION OF HIGHWAYS, STATE OF COLORADO (CDOT)

Standard Specification for Road and Bridge Construction, 1999 Edition.

CDOT Section 506 Riprap

1.3. SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having no designation are for information only. When used, the letters following the "G" designate the office that will review the submittal for the Government. The following shall be submitted in accordance with specification section \=01330=\ SUBMITTAL PROCEDURES.

SD-09 Test Reports

Gradation Test Results; G-AO. (see paragraph 3.3)

Field gradation test results of riprap, intermediate course, and bedding material shall be submitted within 10 days of test completion.

Initial Tests; G-AO. (see paragraph 2.1.6.2)

Initial tests, source, legal description, geologic formation and member, and service record for stone protection.

Waybills and Delivery Tickets;

1.4. *WAYBILLS AND DELIVERY TICKETS*

Copies of waybills or delivery tickets shall be submitted as stone protection material is being delivered to the job site. Before final payment, waybills and certified delivery tickets shall be furnished for all stone protection materials used to complete the project.

PART 2. PRODUCTS

2.1. MATERIALS

2.1.1. General Requirements

All stone for stone protection shall be durable quarried rock as approved by the Contracting Officer's Representative. Individual pieces of stone protection in-place on the embankment shall be free from cracks, seams, and other defects that will cause rapid or excessive deterioration or degradation during service. The bulk stone protection material delivered to the project shall be of such quality that tests performed on representative samples meet all specification requirements. Stone protection shall contain not more than 5 percent of undesirable material by weight. Undesirable material is defined as individual pieces of stone which do not meet quality requirements when tested as specified herein and which can be visually differentiated from satisfactory pieces, plus dirt, sand, clay, and rock fines.

The Contractor shall select the source or sources of material proposed for use and complete initial sampling and testing of materials from each source at least 30 days prior to the time the material is required at the job site.

Stone protection material shall not contain disintegrated granite or shale, smectites, or expanding lattice clay minerals. Stone protection material shall meet the following requirements when tested as specified.

2.1.2. Bulk Specific Gravity

Bulk specific gravity shall be computed based on \-ASTM C 127-\, subject to requirements listed below. Stone protection material shall be tested in a saturated surface-dry (SSD) condition. The computed bulk specific gravity so determined shall not be less than 2.65.

Total sample shall weigh 5000 grams +2 percent.

Individual particles shall weigh approximately 300 grams each.

2.1.3. Soundness in Magnesium Sulfate

Soundness in magnesium sulfate shall be determined according to \-ASTM C 88-\, subject to requirements in the following paragraphs. The combined loss at 5 cycles shall be not more than 8 percent.

2.1.3.1. Sample Preparation.

The sample shall be prepared by breaking it into fragments reasonably uniform in size and shape and weighing approximately 100 grams each. The test sample shall weigh 5000 grams +/- 2 percent. The sample shall be thoroughly washed and dried prior to test for coarse aggregate as defined in \-ASTM C 88-\.

2.1.3.2. Sample Immersion and Temperature.

The sample immersed in the solution shall be maintained at a temperature of 80 degrees +/- 2 degrees Fahrenheit for the immersion period.

2.1.3.3. Quantitative Examination.

At the end of the fifth cycle, the percentage loss shall be determined by the three following methods. The test report shall show the loss computed by each method; however, only the combined loss shall be used for acceptance or rejection of the material.

2.1.3.4. Loss by Breaking.

An individual piece which has broken or split into three or more fragments shall be considered to have failed the test, provided each of the three fragments is at least 10 percent of the original piece by weight. The cumulative weight of all individual pieces failing the test expressed as a percentage of the total original sample weight shall be considered the percentage loss by breaking.

2.1.3.5. Loss by Crumbling and Flaking.

After the loss by breaking has been determined, the remaining sample shall be screened on the 1/2-inch sieve and material which passes the 1/2-inch sieve shall be weighed to determine the combined loss (see paragraph 2.1.3.6, Combined Loss). The total weight of material passing the 1/2-inch sieve shall be expressed as a percentage of the total original sample weight to determine the percentage loss by crumbling and flaking.

2.1.3.6. Combined Loss.

The combined loss shall be determined by adding the total weight of material which fails by breaking to the weight of material passing the 1/2-inch sieve to arrive at a combined loss. The percentage combined loss shall be expressed as a percentage of the total original sample weight.

2.1.3.7. Stone Protection Report.

The report for stone protection rock shall show the percentages of loss calculated as described previously, and the number of pieces affected. The number of pieces affected shall be classified as to the number disintegrating, splitting, crumbling, cracking, or flaking.

2.1.4. Soundness by Freezing and Thawing

Testing for soundness by freezing and thawing shall consist of AASHTO T 103-78, Ledge Rock Method, Procedure C, subject to the following requirements.

Average loss at 50 cycles for five test specimens shall not exceed 10.0 percent.

The maximum loss of any one specimen of the five shall not exceed 35.0 percent.

The average number of "pieces" remaining in each of the five test specimens at the end of the test shall not exceed 3.0, and the maximum number of pieces remaining in any one specimen shall not exceed four.

2.1.4.1. Temperature.

The temperature of the surrounding medium during freezing shall be maintained in the range of -20 to -10 degrees Fahrenheit.

2.1.4.2. Freeze/Thaw Cycle.

The length of a freezing and thawing cycle shall be sufficient to totally freeze and totally thaw each sample particle during each cycle. The laboratory shall specifically determine for each sample that the cycle used is sufficient to accomplish total freezing and total thawing and shall report this in the test report. However, in no case shall the cycle consist of less than 2-1/2 hours of freezing followed by 1 hour of thawing. The sample shall be held in the frozen condition whenever necessary to break the cycle (overnight, weekends, etc.).

2.1.4.3. Immersion.

Procedure C, Partial Immersion shall be used, except that soaking prior to testing shall be in accordance with Procedure A.

2.1.4.4. Test Reports.

Test reports shall describe the type of failure of discrete particles.

2.1.5. Degradation by Abrasion and Impact in the Los Angeles Machine

The riprap sample shall have a percentage of wear not to exceed 40 percent after 1,000 revolutions when tested in accordance with \-ASTM C 535-\.

2.1.6. Sampling and Testing

2.1.6.1. General Requirements.

The Contractor shall perform all quality control sampling and testing. The Government may perform verification tests as determined necessary for final approval of stone protection material. All samples including samples taken during production shall be representative of stone protection material furnished or proposed to be furnished. Samples shall be taken in conformance with \-ASTM D 75-\, or other approved methods.

Test results shall verify all furnished materials comply with requirements in this specification. If the source of material changes for any reason, material from all new sources shall be tested for compliance with specification requirements prior to placement. The Contractor may elect to place material from a new source prior to completion of testing. If deficient test results are obtained, material already placed shall be re-tested to determine the extent of unacceptable material. All in-place, unacceptable material shall be removed and replaced with acceptable material at the cost of the Contractor.

At the same time samples for initial tests are obtained, ledge or ledges in quarries sampled shall be marked with an approved semi-permanent marking which shall be readily visible during the period of riprap production. No rock shall be furnished from any ledge which has not been sampled, tested, and approved for use on this project.

2.1.6.2. /*Initial Tests*/.

Initial (prior to construction) testing shall be performed by the Contractor. The following tests shall be performed on samples of material obtained from each ledge proposed for use as stone protection prior to the start of construction:

- Bulk Specific Gravity (see paragraph 2.1.2)
- Soundness in Magnesium Sulfate (see paragraph 2.1.3)
- Soundness by Freezing and Thawing (see paragraph 2.1.4)
- Degradation by Abrasion and Impact in the Los Angeles Machine (see paragraph 2.1.5)

Certified test results performed not more than 12 months prior to delivery of proposed material to the project. Certified test results, including the name of the quarry owner and legal description of the quarry, shall be submitted to the Government. In addition, the Contractor shall submit a geologic section of each quarry proposed for use with the various rock units identified by geologic name of formation and member, and indicate from what ledge samples were obtained.

2.2. TESTING REQUIREMENTS

2.2.1. Granular Bedding Material

Granular bedding material shall be at least equal in quality to stone used for riprap and shall be well graded between specified sieves. Granular bedding material shall be quarried stone, crushed cobbles, and crushed gravel consisting of particles having at least one fractured face. The material shall be composed of tough, durable particles reasonably free from thin, flat and elongated pieces.

In addition, bedding material shall contain no organic matter or soft, friable particles that classify as soil in quantities in excess of 3 percent of the total weight.

Gradation tests shall be performed on this material after final placement from locations directed by the Contracting Officer's Representative. Samples shall be obtained from each 2,500 square yards of material placed and tested for gradation according to \-ASTM C 136-\ . Material shall be well graded within limits specified in Table 2.

TABLE 2
GRANULAR BEDDING MATERIAL GRADATION REQUIREMENTS

SIEVE SIZE	PERCENT PASSING BY WEIGHT
4-inch	100
3-inch	75-95
3/4-inch	40-60
3/8-inch	20-40
No. 4	5-20

2.2.2. Riprap

Riprap shall consist of stone meeting applicable requirements in Tables 3, 4 and 5. Riprap shall consist of 3 gradations (18-inch, 24-inch, and 36-inch), as indicated on the drawings. Riprap shall be in pieces approximately rectangular in cross section, free from thin slabby pieces having a maximum dimension more than four times the least dimension (elongation). Stone for riprap shall be reasonably well graded from coarse to fine. Quarry operations shall be controlled to produce a reasonably well-graded stone of required size. The Contractor's operations shall be conducted in a manner that will produce stone meeting requirements specified and shall include selective quarrying, handling, and loading as required. Soil and fines less than 1/2-inch in maximum diameter accumulated from interledge layers or from blasting or handling operations shall not exceed 5 percent by weight.

Riprap gradation shall meet requirements of Tables 3, 3A, 4, and 5 below.

TABLE 3
18-INCH THICK RIPRAP LAYER GRADATION REQUIREMENTS

Riprap Designation	D ₅₀ (Inches)	Percent Smaller by Weight	Equivalent Spherical Dimension (Inches)
Type L	9	70-100	15
		50-70	12
		35-50	9
		2-10	3

Alternatively, the contractor may use the following gradation for the 18-inch thick riprap layer gradation.

TABLE 3A
ALTERNATIVE 18-INCH THICK RIPRAP LAYER GRADATION REQUIREMENTS

Riprap Designation	D ₅₀ (Inches)	Percent Smaller by Weight	Equivalent Spherical Dimension (Inches)
Type M	12	70-100	21
		50-70	18
		35-50	12
		2-10	4

TABLE 4
24-INCH THICK RIPRAP LAYER GRADATION REQUIREMENTS

Riprap Designation	D ₅₀ (Inches)	Percent Smaller by Weight	Equivalent Spherical Dimension (Inches)
Type M	12	70-100	21
		50-70	18
		35-50	12
		2-10	4

TABLE 5
36-INCH THICK RIPRAP LAYER GRADATION REQUIREMENTS

Riprap Designation	D ₅₀ (Inches)	Percent Smaller by Weight	Equivalent Spherical Dimension (Inches)
Type VH	24	70-100	42
		50-70	32
		35-50	24
		2-10	9

2.2.3. Fiber-Reinforced Grout

Grout for riprap shall conform to applicable requirements of specification section \=03301=\, CAST-IN-PLACE STRUCTURAL CONCRETE.

Epoxy grout shall meet requirements of ASTM C 881, Type II. Non-shrink grout shall meet requirements of ASTM C 1107, Grades A, B, or C.

PART 3. EXECUTION

3.1. PLACEMENT

3.1.1. Granular Bedding Material

Granular bedding material shall be spread uniformly on the prepared subgrade to meet thickness and grade requirements indicated on the drawings. Placement of material by methods which result in segregation of particle sizes within the bedding shall not be permitted. Any damage to the surface of the granular bedding subgrade prior to or during placement of the bedding shall be repaired before proceeding with the work. Compaction of granular bedding material shall not be required but it shall be finished to present a reasonably even surface free from depressions, mounds, or windrows.

3.1.2. Riprap

Riprap shall be placed on the prepared subgrade or on granular bedding material as shown on the drawings. Riprap stone shall be placed in such manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid damage to the bedding material and to minimize segregation of riprap. Larger stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded to conform to the specified gradation. Finished riprap shall be free from pockets of small stones and clusters of larger stones. Placing riprap in layers will not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source, or by controlled dumping of successive loads during final placement.

All stone shall be placed by means of clam, orange peel, or skip box. Zero drop height placement procedures are to be utilized for riprap stone to avoid displacing or damaging the underlying subgrade or granular bedding. Dumping of stone at the top of slopes and rolling or pushing into place shall not be permitted. Manipulating or moving stone at any time prior to placement by means of dozers or other blade equipment shall not be permitted. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to obtain a reasonably well graded distribution of stone sizes as specified above.

3.1.3. Grout

Cement grout shall be placed after riprap has been constructed and accepted within gradation limits specified. Grout shall completely fill all interstices between riprap. The finished surface shall be smooth, solid, and true to line, grade, and section. Grout shall not be placed when the ambient temperature is below 35° F or above 85° F, or when grout is likely to be subjected to temperatures less than 35° F within 72 hours after placement.

3.2. *FIELD GRADATION TEST*

A field gradation test of 18-inch, 24-inch, and 36-inch riprap materials shall be performed by the Contractor to determine if materials delivered to the job site meets gradation requirements of this specification. A sample consisting of 2 to 8 tons shall be taken of each riprap gradation delivered to the job site and checked for gradation and elongation. Gradation shall be determined according to \-ASTM D 5519-\.

Material from initial tests that meets specification requirements shall be placed in a well marked area designated by the Contracting Officer's Representative, to serve as a visual model for acceptable material. Material that does not meet specification requirements shall not be counted as a required test. The Contractor shall provide a written statement regarding the method of blasting, processing, loading, and handling material, and shall notify the Contracting Officer's Representative if production methods change. Riprap material shall not be placed in areas shown on the drawings until material delivered to the job site passes the field gradation test.

If material fails the field gradation test, the Contractor shall propose another source of material and verify with additional testing that acceptable materials can be produced from the new source prior to placing riprap in areas shown on the drawings.

3.3. PROTECTION

The Contractor shall maintain riprap until final acceptance by the Contracting Officer's Representative. Material displaced by any cause shall be replaced to its original position at the expense of the Contractor.

SECTION 02246

GROUTED STONE BOULDER CONSTRUCTION 10/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

\-ASTM C 88-	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
\-ASTM C 127-\	(1988; R 1993) Specific Gravity and Absorption of Course Aggregate
\-ASTM C 309-\	(1995) Liquid Membrane-Forming Compounds for Curing Concrete
\-ASTM C 535-\	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
\-ASTM D 75-\	(1987; R 1992) Standard Practice for Sampling Aggregates

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

\-AASHTO T 103-78\	(1978) Soundness of Aggregates by Freezing and Thawing (Ledge Rock-Large Specimen)
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ACI INTERNATIONAL (ACI)

\-ACI 305-\	(1991) Hot Weather Concreting
\-ACI 306-\	(1991) Cold Weather Concreting

1.2 GENERAL

The work specified herein consists of construction of grouted stone boulder protection for all grouted stone boulder drop structures and for construction of grouted stone boulder trickle channel sidewalls, as shown on the drawings and as directed by the Contracting Officer's Representative. This work consists of furnishing all labor, equipment, and materials and performing all work necessary to place stone boulder protection materials and to place surrounding fiber-reinforced grout material in the void areas between the stone boulders. Stone boulder material shall consist of all stone to be furnished for grouted stone boulder construction. The Contractor shall control operations during production of grouted stone boulder protection materials so as to insure that the material delivered and placed will meet all specification requirements. The Contractor shall perform all sampling and testing required for quality control in accordance with Section \=01451=\ CONTRACTOR QUALITY CONTROL and as specified herein. The quarry operators shall be responsible for operating all quarries and for conditioning the area after operations are complete, in accordance with all applicable Federal, State, and local laws and regulations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having no designation are for information only. When used, the letters following the "G" designate the office that will review the submittal for the Government. The following shall be submitted in accordance with Section \=01330=\ SUBMITTAL PROCEDURES:

SD-06 Test Reports

Initial Sampling and Testing; G-AO.

Field Gradation; G-AO.

Field Gradation Test Results mailed within ten (10) days after completion of the tests.

Stone Protection Report; G-DO

Two (2) copies of the Stone Protection Report shall be submitted for approval within ten (10) days after completing soundness in magnesium sulfate testing (see paragraph 1.5.1.6).

Waybills and Delivery Tickets .

1.4 *WAYBILLS AND DELIVERY TICKETS*

Copies of waybills or delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed, waybills and certified delivery tickets shall be furnished for all grouted stone boulder construction materials actually used in the construction.

1.5 SAMPLING AND TESTING

1.5.1 Stone Boulder Materials

The Contractor shall be responsible for all sampling and testing specified herein. The Government may perform verification tests as determined necessary for final approval of the stone protection material. All samples including samples taken during production shall be representative of the stone boulder material furnished or proposed to be furnished. Samples shall be taken in accordance with \-ASTM D 75-\ or other approved method. No stone boulders shall be furnished from any ledge which has not been sampled, tested, and approved for use on this project.

1.5.1.1 Test Results

Results shall verify that materials comply with this specification. When a material source is changed, the new material will be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or modified as directed by the Contracting Officer's Representative.

1.5.1.2 *Initial Sampling and Testing*

Tests for bulk specific gravity, soundness in freezing and thawing, and absorption shall be performed on samples of material obtained from each ledge proposed for use as stone boulder protection material prior to start of

construction. Test results shall describe type of failure of the discrete particles. Certified test results performed not longer than 12 months prior to delivery to the project together with the name of the owner of the quarry and the legal description shall be submitted to the Contracting Officer's Representative. The Contractor shall submit the name and location of each quarry proposed for use along with a geologic section of each quarry indicating the various rock units identified by geologic name of formation and member and indicate from what ledge the samples were obtained.

1.5.1.3 Bulk Specific Gravity

Bulk specific gravity shall be computed on a saturated dry basis in accordance with \-ASTM C 127-\ . Stone boulder protection material shall be tested in a saturated surface-dry (SSD) condition. The computed bulk specific gravity so determined shall not be less than 2.50.

1.5.1.4 Absorption

Absorption of the proposed materials shall be determined according to \-ASTM C 127-\ . Total measured absorption shall not exceed 2.0 percent.

1.5.1.5 Soundness in Freezing and Thawing

The test for freezing and thawing shall consist of \-AASHTO T 103-78\, Ledge Rock Method, Procedure A. The loss at 50 cycles shall not exceed 10.0 percent. The test report shall describe the type of failure of the discrete particles.

1.5.1.6 Soundness in Magnesium Sulfate

Soundness in magnesium sulfate shall be determined according to \-ASTM C 88-\, subject to requirements in the following paragraphs. The combined loss after 5 cycles shall not be more than 8 percent.

Sample Immersion and Temperature: The sample immersed in the solution shall be maintained at a temperature of 80 degrees +/-2 degrees Fahrenheit for the immersion period.

Quantitative Examination: At the end of the fifth cycle, the percentage loss shall be determined by the three following methods. The test report shall show the loss computed by each method; however, only the combined loss shall be used for acceptance or rejection of the material.

Loss by Breaking: An individual piece which has broken or split into three or more fragments shall be considered to have failed the test, provided each of the three fragments is at least 10 percent of the original piece by weight. The cumulative weight of all individual pieces failing the test expressed as a percentage of the total original sample weight shall be considered the percentage loss by breaking.

Loss by Crumbling and Flaking: After the loss by breaking has been determined, the remaining sample shall be screened on the 1/2-inch sieve and material that passes the 1/2-inch sieve shall be weighed to determine the combined loss (see paragraph below). The total weight of material passing the 1/2-inch sieve shall be expressed as a percentage of the total original sample weight to determine the percentage loss by crumbling and flaking.

Combined Loss: The combined loss shall be determined by adding the total weight of material that fails by breaking to the weight of material passing the 1/2-inch sieve to arrive at a combined loss. The percentage combined loss shall be expressed as a percentage of the total original sample weight.

The Contractor shall submit a stone protection report (see section 1.3, Submittals) that shows the percentages of loss calculated as described above, and the total number of pieces affected. The number of affected pieces shall be classified as to the number disintegrating; splitting; crumbling; cracking; or flaking.

1.5.1.7 Degradation by Abrasion and Impact in the Los Angeles Machine

Abrasion of the proposed stone boulder materials shall be done in conformance with \-ASTM C 535-\, using Los Angeles Machine, Grading 1. Total material weight loss after 1,000 revolutions shall not exceed 40.0 percent.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Stone Boulder Material

2.1.1.1 General Requirements

The Contractor shall furnish to the Contracting Officer's Representative, without cost to the Owner, such samples of stone boulder materials for any testing that may be required by the Contracting Officer's Representative from proposed quarry sites and from rock materials delivered to the site. The Contracting Officer's Representative reserves the right to make inspections of the quarry sites and the quarries. The approval by the Contracting Officer's Representative of some material from a particular quarry site or quarry shall not be construed as constituting the approval of all material taken from that quarry site or quarry, and the Contractor will be held responsible for the specified quality and gradation of stone boulder materials delivered to the site. All stone boulder materials not meeting the requirements of these Specifications as determined by weight tests and/or inspections at the quarries and site, will be rejected and any rejected material at the site shall be disposed of in an approved manner at the expense of and by the Contractor.

2.1.1.2 Quality

Stone or rock fragments of the quality and gradations specified herein shall be furnished by the Contractor. Asphalt, broken concrete, concrete slabs, or other materials not classified as rock will not be allowed for use as stone boulder material. No shale and/or organic materials shall be allowed for use as stone boulder material. Furthermore, no boulder shall have a breadth or thickness less than 2/3rds the length, including sample stone boulders for acceptance testing.

All grouted stone boulder materials shall be durable quarried rock as approved by the Contracting Officer's Representative. Rhyolite rock shall not be used for any grouted stone boulders. Grouted stone boulders shall be free of calcite intrusions. Individual boulders in-place shall be free from cracks, seams, and other defects that will cause rapid or excessive deterioration or degradation during service. The Contractor shall select the source or sources he proposes to use and perform the initial sampling and testing of the materials well in advance of the time when the material will be required in the work.

2.1.1.3 Dimensions

The breadth (B), thickness (T), and length (L) of any piece of stone boulder shall not be less than the dimensions specified below. These axes or planes for the boulders are described as follows:

- L - Longitudinal axis. Represents the center line (axis) connecting the most distant points (faces, noses, or apices) of the boulder.
- B - Represents the center line within the stone boulder that intersects the L-axis at right angles.
- T - Represents the center line within the rock that is perpendicular to the L-B planes.

Boulders for use in construction of trickle channel sidewalls shall provide a cross section of approximately 3'-0"x 3'-0" (LxB or BxT); the third dimension of the boulder may vary at Contractor's discretion, but shall be not less than 1'-0" nor more than 9'-0". It is intended that the general shape of boulders for use in trickle channel sidewall construction be angular and blocky (e.g., roughly rectangular in cross section and profile).

Boulders for use in Grouted Stone Drop structures shall provide at least one dimension (L) of approximately 3'-6". It is intended that the boulders present a generally rounded appearance for that portion of the boulder extending above the surface of the grout. At Contractor's option, boulders for use in Grouted Stone Drop structures may consist of naturally occurring boulders selected for dimension and general shape, meeting the minimum stone quality requirements specified above.

The following table provides classification and size requirements for boulders used in trickle channel sidewalls and drop structures.

BOULDER SIZE REQUIREMENTS

Boulder Classification	Nominal Size	Range in Smallest Dimension of Individual Boulders	Maximum Ratio of Largest to Smallest Dimension of Individual Boulders
B36	36"	34" - 38"	1.75
B42	42"	40" - 44"	1.65

Control of gradation will be by visual inspection. The Contracting Officers Representative may request a visit to the quarry to check gradation prior to delivery of grouted stone boulders to the project site.

2.1.2 Fiber Reinforced Grout Material

All product and material information for fiber-reinforced grout is covered in specification section 03301, CAST-IN-PLACE STRUCTURAL CONCRETE.

2.1.3 Bedding

All product and material information for bedding material is covered in specification section 02240, STONE (RIPRAP) PROTECTION.

2.1.4 Drain Blanket

All product and material information for drain blanket material is covered in specification section 02210, GRADING.

2.1.5 Metal Sheet Piling Cutoffs

Material and installation shall conform to the requirements of Section 02411, Metal Sheet Piling. Piling shape shall be of the Z type, providing a minimum section modulus of 10.4 in³ per foot of width, and a minimum weight of 15.3 pounds per square foot of wall. At Contractor's option, and to the extent available, steel sheet piling used in construction of temporary excavation support in the vicinity of sta. 50+00 and sta. 57+10 may be salvaged and reused in the Grouted Stone Drop structures. The Contracting Officer may reject any individual pile which in his judgment has been damaged from previous installation and pulling operations to the extent that adequate interlock and pile shape has been compromised.

PART 3 EXECUTION

3.1 GENERAL

Quarry operations shall be controlled to produce reasonably well-graded stone boulders of required size, and the Contracting Officer may require changes as necessary to produce the required product. The Contractor's operations shall be conducted in a manner that will produce stone meeting the requirements specified and shall include selective quarrying, handling, and loading as required.

3.1.1 Grouted Stone Drop Structures

Bedding composed of the specified bedding material (and drain blanket where indicated) shall be placed on the prepared subgrade where indicated on the drawings to form a backing for the grouted stone boulder protection. Grouted stone boulder placement shall follow placement of bedding and drain blanket material.

3.2 PLACEMENT

3.2.1 Bedding

Bedding material under grouted stone boulder protection material shall be spread as indicated on the drawings and in specification section \=02240=\, STONE RIPRAP) PROTECTION.

3.2.2 Drain Blanket

Drainage blanket materials shall be placed within the grouted stone boulder blankets as indicated on the drawings and in specification section \=02210=\, GRADING.

3.2.3 Metal Sheet Piling Cutoffs

Metal sheet piling cutoff walls shall be placed within the grouted stone boulder blankets as indicated on the drawings and in specification section \=02411=\, METAL SHEET PILING.

3.2.4 Stone Boulders

Stone boulders shall be placed with a flat surface of the boulder positioned horizontally at the top. Stone boulders shall be placed with a minimum of gaps so that each boulder is as close as practical to adjacent boulders. The void space between boulders shall not exceed 4 inches. The intent of construction is to place adjacent boulders so they touch one another to minimize voids and grout required between boulders. Boulders shall be picked and arranged so the adjacent rock surfaces match within 2 inches in top elevation and 2 inches along the vertical exposed face or channel side of boulders unless otherwise shown on the

drawings. Boulders shall be individually placed in a manner to avoid displacing underlying materials or placing undue impact force on underlying materials. Each stone shall be placed to essentially the final position by the use of a multi-prong grapple device or suitable equipment for handling materials and, if necessary, the stone shall be picked up and repositioned. Dragline buckets and skips shall not be used for placement of stone boulders. Moving stone by drifting or manipulation down a slope will also not be permitted. Boulders shall not be dropped from a height of greater than 1.0 foot. It should be anticipated by the Contractor that rehandling of individual stone boulders after initial placement will be required to achieve required slopes, grades, elevations, and position. The Contracting Officer's Representative shall observe all stone boulder placement and approve of the placement before grout is placed.

After stone boulder placement is approved, fiber-reinforced grout shall be poured between the stone boulders (see paragraph 3.2.6, below). Stone boulders shall be clean and thoroughly moistened before concrete grout is poured against them. Grout shall fill all gaps between stone boulders as shown on the drawings. The tops of the stone boulders shall not be covered by grout. After grout placement, exposed surfaces of the stone boulders shall be thoroughly cleaned to remove all concrete laitance. Any stone boulders displaced during the backfilling operation shall be replaced and regouted in position at the Contractor's expense.

3.2.4.1 Grout Setting Bed for Boulders in Trickle Channel Sidewalls

Prior to setting boulders for trickle channel sidewalls, a setting bed of 4" of fiber reinforced grout shall be applied to the grouted stone boulder foundation. The boulders shall be positioned while the grout is still fluid; additional grout packing of the boulder setting bed will not be required.

3.2.5 Form Perimeter of Grouted Stone Boulders

Where shown on the drawings, the edge of the grouted stone boulder construction shall be formed to full height.

3.2.6 Fiber-Reinforced Grout

3.2.6.1 General

Before placement of grout, stone boulders shall be thoroughly moistened and debris, fines, or silt shall be removed from above, around, or under boulders.

Grout shall be delivered to the place of final deposit by a low-pressure grout pump, with a pressure of less than 10 psi using a 2-inch diameter nozzle. A concrete pump truck system will also be acceptable provided the pump pressure can be altered to provide the necessary slow delivery amounts. Penetration of the grout around the stone boulders shall be required using a pencil vibrator. The top surface of the stone boulder layer shall be left exposed above the grout surface as shown on the drawings. After placement, all exposed stone boulders with grout splashed on the surface shall be cleaned with a wet broom. All grout between stone boulders shall be finished with a broom finish to result in the finished grout line 3 inches below the top of adjacent stone boulders. Any holes or voids evident after vibrating or brooming shall be filled with additional grout material. All grout shall be uniformly sprayed with a clear liquid membrane curing compound as specified in ASTM C 309. If stone boulders cannot be cleaned of excess concrete, a solution of muriatic acid will be used to clean stone boulders.

3.2.6.2 Cold Weather Grout Placement

When depositing grout material when the mean daily temperatures are below 40 degrees F, follow recommendations of ACI 306. Maintain grout temperature at a minimum of 55 degrees F for sections having a thickness of less than 12 inches or a minimum of 50 degrees F for sections having a thickness of 12 inches or greater, for not less than 72 hours after depositing the grout material. Do not place grout without approval of the Contracting Officer's Representative on days when the temperature at 9:00 a.m. is below 30 degrees F. No grout is to be placed on snow, ice, frozen material, unsuitable ground conditions, or water.

3.2.6.3 Hot Weather Grout Placement

When depositing grout material in hot weather, follow recommendations of ACI 305. The temperature of grout at time of placement shall not exceed 90 degrees F. Grout material shall be protected to prevent rapid drying. Finishing and curing shall start as soon as possible. When the air temperature is expected to rise above 90 degrees F, the Contractor shall obtain approval from the Contracting Officer's Representative of the procedures to be used in protecting, depositing, finishing, and curing the grout. The specified water reducing and retarding admixture may be used upon approval of the Contracting Officer's Representative. The use of continuous wetting or fog sprays may be required by the Contracting Officer's Representative for 24 hours after depositing the grout material or the work may be restricted to evenings or nights, especially in times of low humidity.

3.3 PROTECTION

The Contractor shall maintain the grouted stone boulder construction until accepted and any material displaced by any cause shall be replaced at his expense to the lines and grades shown on the drawings.